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REFRIGERATION APPARATUS WITH AIR FLOW BY-PASS MEANS

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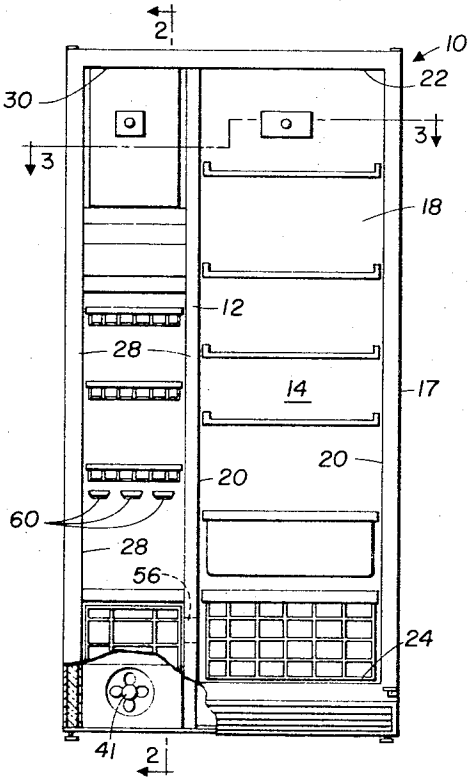


FIG 1

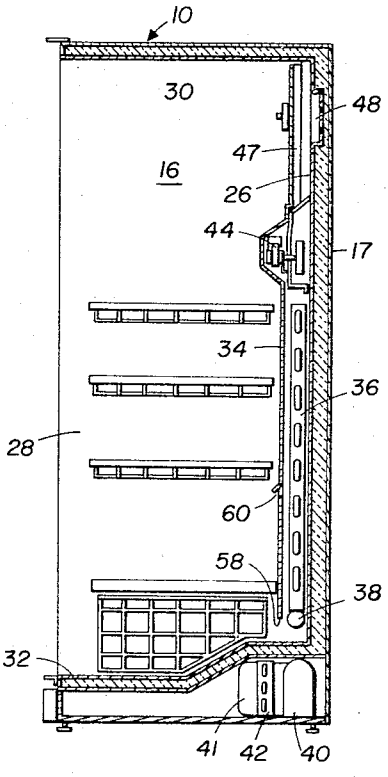


FIG 2

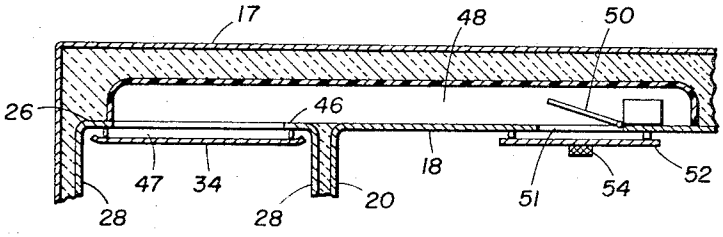


FIG 3

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REFRIGERATION APPARATUS WITH AIR FLOW BYPASS MEANS

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ABSTRACT OF THE DISCLOSURE

An air circulation and distribution system for a combination freezer-refrigerator employing a finned coil type evaporator through which air is circulated longitudinally of the fins. Undue frosting of the leading edges of the evaporator fins, owing to the circulation of large quantities of moist air from the refrigerator compartment, is prevented from dangerously reducing air flow through the evaporator by means of bypass return air openings downstream of the main return air openings which permit the return air to bypass the leading edges of the fins. The main and bypass return air openings are sized so that the latter do not become substantially effective until the leading edges of the fins become frost clogged.

Background of the invention

The combination freezer-refrigerator in which the refrigerator and freezer compartments have separate access doors is considered a substantial improvement over a single large compartment unit containing a small freezer compartment. Early models of such two-door combinations typically had a separate evaporator for each compartment and no forced air circulation. Subsequent improvements and modifications led to the adoption of an arrangement in which the refrigerated air was forcibly circulated throughout the refrigerator and freezer compartments and over the evaporators. In such arrangements frost tends to form on the evaporators, which frost may be periodically removed by employing a reversible refrigeration system or by electric heating elements embedded in the evaporators. The simplest and thus the most economical and reliable form of periodic defrosting is that performed on a fixed time-cycle basis. However, a disadvantage of the fixed defrost cycle when finned type evaporators are used is that frost may build up on the fins, especially on those of the evaporator of the relatively moist refrigerator compartment, between defrost cycles to the point where the flow of air through the evaporator is substantially reduced. This is particularly true in systems where but a single finned evaporator is used to cool both the refrigerator and freezer compartments, as is current practice. Normally, frost build-up is greatest on those portions of the fins initially contacted by the warm humid air returning from the refrigerator compartment. If sufficient blockage of the air flow occurs, the resulting rise in temperature of the compartments may cause food spoilage. The problem is made more acute because of the desirability of utilizing all available space for food storage while keeping the over-all size of the refrigeration components at a minimum.

Summary of the invention

The invention herein provides an arrangement whereby it is virtualy impossible for the air flow to become blocked by reason of frost build-up on the evaporator fins. This is accomplished in a very simple and inexpensive manner, in great contrast to other methods of dealing with the problem, by providing additional or bypass openings leading the return air into the evaporator downstream from the main return opening. The bypass openings are sized and located so that the return air will normally not flow through them but rather substantially all through the main return opening as long as frost build-up does not substantially impede the flow through the evaporator.

The details and features of the invention will be more readily apparent from a consideration of the following description of a preferred form thereof, being the best mode known of carrying out the invention.

Brief description of the drawings

FIG. 1 is a front elevational view of a freezer-refrigerator combination, the doors being omitted and a portion of the liner of the freezer compartment being broken away to show some of the refrigeration components;

FIG. 2 is a vertical sectional view taken along the line 2—2 of FIG. 1 through the freezer compartment; and

FIG. 3 is a sectional view through a portion of the freezer compartment taken along the lines 3—3 of FIG. 1 and illustrating the duct arrangement by which the air is circulated into the freezer and refrigerator compartment.

Description of a preferred embodiment

The freezer-refrigerator combination shown in the drawings is one in which the refrigerator and freezer compartments are side-by-side. The cabinet, indicated generally by the reference numeral **10**, has a central vertical partition **12** which separates the cabinet into a refrigerator compartment **14** and a freezer compartment **16**. Separate doors (not shown) are provided to close the respective compartments.

The cabinet **10** includes an outer cabinet wall **17** and a pair of inner liners spaced therefrom by suitable insulation, as is well known to those skilled in the art, to form the refrigerator compartment **14**, and the freezer compartment **16**, respectively, and the partition **12**. The refrigerator liner provides a back wall **18**, side walls **20**, a top wall **22** and a bottom wall **24**. Similarly, the freezer liner provides a back well **26**, side walls **28**, a top wall **30**, and bottom wall **32**.

As best seen in FIG. 2, a vertical panel **34** is spaced forwardly of the back wall **26** of the freezer to provide a compartment in which an evaporator **36** is positioned. Evaporator **36** is of the finned type and is disposed upright with its fins extending vertically. An accumulator **38** is horizontally disposed below the evaporator **36**, and the remaining major refrigeration components, including a compresser **40**, a fan **41** and a condenser **42** are located beneath the bottom wall **32** of the freezer compartment which is upwardly shaped at its rear to provide space therefor.

In order to circulate the air so that return warm air from the compartments **14** and **16** is cooled by passing between the fins of evaporator **36**, a fan **44** is located between the vertical panel **34** and back wall **26** of the freezer compartment **16**. The fan **44** is located above and downstream from the evaporator **36** and discharges air upwardly into a passageway **47** formed by the upper end of the vertical panel **34** and the back wall **26** of the freezer compartment. In order to provide for discharge of cool air into the freezing compartment **16**, the side edges of the vertical panel **34** above the fan **44** are spaced inwardly from the side walls **28**, and are preferably turned rearwardly, as best seen in FIG. 3.

To provide for circulation of air into the refrigerator compartment **14**, a horizontal molded duct **48** is disposed in the insulation between the back wall **26** and the outer cabinet wall **17** and connects the upper end of the passageway **47** with the refrigerator compartment **14**. The duct **48** opens into the refrigerator compartment **14** through a thermostatically controlled damper **50** which regulates the size of the discharge opening **51** into the refrigerator

compartment **14**. A thermostat (not shown) on the rear of the diffuser plate **52** is responsive to the air temperature in the refrigerator compartment and controls operation of the damper **50**. A thermostat (not shown) in the freezer compartment **16** controls operation of the compressor **40** and fans **41** and **44** to regulate the temperature in the latter compartment. Preferably a manual control **54** is provided on the front face of diffuser **52** by which the extent of the movement of damper **50** may be controlled.

The warm air returning to the evaporator **36** from the refrigerator compartment **14** passes through a lower duct **56** formed in the partition **12** between the back wall **26** of the freezer compartment and the panel **34** at a point below the evaporator **36**. Return air from the freezer compartment **16** is circulated back to the evaporator **36** by means of an opening **58** formed by termination of the vertical panel **34** short of the bottom wall **32** of the freezer, as shown in FIG. 2. Thus, the return air from both compartments **14** and **16** conjoin for passage up through the evaporator **36**.

Defrosting of the evaporator **36** is accomplished by electric heating elements (not shown) embedded in the evaporator and energized by a timer having a fixed cycle of eight hours. Defrost systems of this and other types are well known to those skilled in the art and as they form no part of the invention herein are not disclosed in any further detail.

As mentioned, in the case of defrost systems that operate on a fixed time cycle, frost build-up on the fins of evaporator **36** may occur between defrost cycles to such an extent that the flow of air across the evaporator will be substantially blocked. As is well known to those skilled in the art, such frost build-up readily occurs first and most heavily on that portion of the evaporator fins initially contacted by the return air from the freezer and refrigerator compartments during periods of frequent door openings, especially of the latter compartment. Inasmuch as most moisture is removed from the air by the initial portion, that is to say, the lower ends of the fins of the evaporator **36**, further cooling of the air by passage up through the remaining portion of the evaporator fins causes comparatively little frost formation. In order to avoid the possibility of air circulation being impaired by the formation of excessive frost on the lower end of evaporator **36**, one or more openings **60** are provided in panel **34** of the freezer compartment **16**. These openings **60** provide a bypass or supplementary inlet for circulation of air from the freezer compartment **16** positioned above the lower portion of the evaporator **36** where heavy frosting may occur. The openings **60** are of such a size and their position is such that return air from the freezer compartment **16** will normally pass through the much larger main opening **58** and thus through the entire length of the evaporator **36**. The openings **60** therefore provide temporary circulation of the air in the event of frost blockage of the lower end of the evaporator **36** until such frost can be removed during the next defrost cycle. The bypass openings **60** thus provide a very simple solution to the problem concerned without the necessity, for instance, of dividing the evaporator into separate portions for the refrigerator and freezer return air, or of any of the other much more elaborate and costly methods employed for the purpose by the prior art.

Having thus described the invention, it will be apparent to those skilled in the art that various revisions and modifications can be made in the particular embodiment shown without departing from the spirit and scope of the invention. For example, it will be obvious to those skilled in the art that the principles of the invention can be utilized in top and bottom mount freezer-refrigerators as well as the side-by-side unit illustrated herein. Thus, all

revisions and modifications to the specific illustrated embodiment shown herein as are obvious to those skilled in the art are to be included within the scope of the following claims.

I claim:

1. In a combination freezer-refrigerator having a cabinet defining a refrigerator compartment and an adjacent freezer compartment separated by a partition wall, a refrigeration system including an evaporator of the finned coil type to cool air circulated therethrough, and a forced air circulation system having an air passageway which includes a wall of one of said compartments, said evaporator being disposed in said passageway so that said air passes between and generally longitudinally of the fins of said evaporator, said passageway terminating in an air outlet opening into said refrigerator compartment and an air outlet opening into said freezer compartment, said passageway also having a main return air inlet opening thereto upstream of one end of the fins of said evaporator and communicating with both of said compartments, the improvement comprising one or more air bypass openings in said air passageway wall from said one compartment and disposed to communicate with said passageway downstream of said end of the fins of said evaporator, each of said bypass openings being sufficiently small relative to said main inlet openings so that return air normally flows substantially only through said main inlet openings into said passageway until air flow from said main inlet openings through said end of the fins of said evaporator becomes substantially reduced owing to frost buildup between the fins at said end thereof.

2. The air circulation system of claim **1** in which said passageway extends vertically along a wall of one of said compartments and said inlet openings are at the lower end of said passageway, said bypass openings being located above said inlet openings and providing for the circulation of air over all but the lower end portion of the fins of said evaporator.

3. The air circulation system of claim **2** in which said compartments are located side-by-side and separated by a vertical partition, said passageway being formed between the rear wall of said freezer compartment and a panel spaced forwardly thereof, said inlet opening from said freezer compartment to said passageway being disposed adjacent the bottom of said compartment below said evaporator and a lower edge portion of said panel, said outlet opening into said freezer compartment from said passageway being formed along the upper edge portions of said panel, a fan located in said passageway between said evaporator and said outlet effective to move air through said inlet, said evaporator and said outlet, a laterally extending air supply duct communicating with said passageway adjacent said outlet to said freezer compartment and terminating at said outlet to said refrigerator compartment, a laterally extending air return duct communicating with said inlet opening of said refrigerator compartment and terminating adjacent said inlet opening of said freezer compartment to said passageway, said bypass openings being disposed in said panel, and means disposed adjacent said outlet to said refrigerator compartment effective to control the quantity of air admitted thereto.

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